The Forward and Backward Linkage Effects of the Energy Sector in Turkey

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Abstract: Energy sector has a great importance for producers and consumers. Energy sector has been found as a leading sector as a result at the input-output analysis. This analysis has been done by using input-output tables which are constructed by goverment Statistical Institude. Turkey is dependent to other countries as energy. To satisfy the development in Turkish economy is only available by reducing the depandencies to the other countries by the energy. Also it should be continued as the leading sector.

Key Words: Input-Output Analysis, Energy Sector.

Introduction

Energy constitutes the most important causes of wealth through a variety of manifestations. Besides water, coal. Petroleum and other valuable resources, the existence of wind and sun are sources of wealth as well.

Energy resources are used as inputs by other sectors in manufacturing industries. Therefore, it is important to know the forward and backward linkages of this sector for the general situation of the economy.

The importance of energy resources has doubled in Turkey because of the energy crises experienced in recent years. In this context, this study aims to find and interpret the forward and backward linkage effects of the energy sector.

The purpose in this study is to observe the direct and indirect effects of input exchange between sectors and their change over the years. The main data set used in the study is the Input-Output Flow Tables about Turkish economy that is prepared by the Turkish Statistical Association (TUIK). The data for 1996, 1998 and 2002 are used in the study.

The Importance of the Energy Sector

An increase in energy prices also increases the costs of inputs and product prices. Energy prices that are not fixed influence inflation and increase the pressure for economic stagnation through affecting total demand. The more important the use of energy resources in an economy the higher the inflationist pressure against the increases in oil prices (LeBlanc and Chinn, 2004: 8).

Increases in the prices of energy resources raise the costs of airways, transportation and the costs of the companies that produce chemical products and therefore, lead to inflation. For this reason, any change in energy prices is watched very closely (Bennet, 2003: 1).

Plants in the energy sector should be planned long before the demand for energy exists. Otherwise, delays in planning and investments raise the cost of energy and adversely affect economic activities and societal wealth. It is imperative to determine the potential needs in the energy sector at least ten years in advance, decide the projects to cover the increasing demand, and make necessary political decisions (Gerek, 1998: 370-371).

In developing countries like Turkey, the sectors that produce energy have important structural ties with other sectors. Especially electricity sector in Turkey positively affect economic growth because of its backward linkage. In today's modern societies, electrical energy used increasingly ignite other sectors of the economy by providing considerable amounts of inputs. The insufficiency of electric energy supply that should increase parallel to economic growth adversely affects economic growth as well as prevents the stimulatory effect on the economy (Terzi, 1998: 63).

Input-Output Analysis

The input-output model is a model that considers the relationship between the level of activities in the all sectors of economy (Akkaya and Pazarlioglu, 2000: 14).

The input-output models are simple mathematical equilibrium models that quantitatively analysis the mutual linkages between production and consumption units on the whole economy scale in a multi-sectoral way. Different from micro economical analysis that focuses on the behaviors of firms and households and macro-economic analysis that analyzes the whole economy, the input-output analysis' focus is on sectors and good exchanges between sectors. The input-output models provide an opportunity to quantitatively analyze the production and use of outputs of productive sectors on whole economical and sectoral basis and fulfill and important gap between partial and total analyses especially in the analysis of empirical problems (Aydogus, 1999: 1-2).

In the input-output model, under the assumption that the share of technology or inputs in production costs is constant, the equilibrium prices of goods and services produced in every sector can be obtained as the prices of main inputs (Aydogus, 1993: 36).

According to Hirschman, the effects of forward and backward linkages that reflect sectors' "feeding" and "stimulating" powers on other sectors must be considered (Hirschman, 1958: 9). In Hirschman's unbalanced growth model, one of the most important factors that restricts economic growth is the ability of decision making, especially the ability to take an investment decision.

Inferring from Hirschman's ideas, a quadruple grouping can be developed. The categories of this grouping that considers forward and backward linkages together can be summarized as follows:

Category 1: Sectors that have high forward and backward linkage effects.

Category 2: Sectors that have high backward but low forward linkage effects.

Category 3: Sectors that have high forward but low backward linkage effects.

Category 4: Sectors that have low backward and forward linkage effects.

The above arrangement shows sectoral investment priorities from the lowest to the highest. According to this, the sectors in the first category constitute the key sectors in the economy and have the highest investment priority. The scarce resources should primarily be devoted to these sectors. If there are still unused resources, then, they should be devoted to the sectors in the second category. Sectors in the III. and IV. categories come last in terms of investment priorities, that is, these sectors are expected to be stimulated by the key sectors (Aydogus, 1999: 100-101).

The Forward and Backward Linkage Effects for 1996, 1998, and 2002

The 1996 and 1998 input-output tables prepared by TUIK consist of total 97 sectors and the 2002 table consists of 59 sectors. The forward and backward linkage effects are as follows in terms of sectoral arrangement. The Table consists of 97 sectors but to observe it more clearly it is divided. In Table 1, there are Forward Linkage Effects (FLE) and Backward Linkage Effects (BLE) of 24 sectors.

Sectors	1996 İBE	1996 GBE	1998 İBE	1998 GBE	Sectors	2002 İBE	2002 GBE
1-Growing of cereals and other crops n.e.c.	5,89	1,66	5,07	1,42	Agriculture, hunting and related service activities	1,86	3,66
2-Growing of vege- tables, horticultural specialities and nursery products	1,21	1,50	1,23	1,31	Forestry, logging and related service activities	1,35	1,45
3-Growing of fruit, nuts, beverage and spice crops	1,54	1,20	1,89	1,14	Fishing, operating of fish hatcheries and fish farms; service activities incidental to fishing	1,64	1,06
4- Farming of animals	2,53	1,93	2,00	1,74	Mining of coal and lignite; extraction of peat	1,60	1,37
5-Agricultural and animal husbandry service activities (excl. veterinary act.)	1,92	2,13	1,42	1,78	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying	1,05	3,24
6-Forestry, logging and related service activities	1,87	1,22	1,72	1,17	Mining of uranium and thorium ores	1,00	1,00
7- Fishing	1,16	1,41	1,15	1,26	Mining of metal ores	1,92	1,16
8- Mining of coal and lignite	1,65	1,33	1,50	1,44	Other mining and quarrying	2,14	1,82
9-Extraction of crude petroleum and natural gas	4,31	1,23	1,32	1,25	Manufacture of food products and beverages	2,95	2,52
10- Mining of metal ores	1,26	1,61	1,16	1,45	Manufacture of tobacco products	2,79	1,14
11- Quarrying of stone, sand and clay	1,33	1,40	1,38	1,27	Manufacture of textiles	2,98	3,81
12- Mining and Quarrying n.e.c.	1,23	1,31	1,24	1,23	Manufacture of wearing apparel; dressing and dyeing of fur	3,21	1,32
13- Production, proces- sing and preserving of meat and meat products	1,72	2,49	1,55	2,07	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	2,94	1,69
14-Processing and preserving of fish and fish products	1,11	1,86	1,02	1,74	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	2,88	1,68
15- Processing and preserving of fruit and vegetables	1,13	1,96	1,37	1,70	Manufacture of pulp, paper and paper products	2,59	3,99
16- Manufacture of vegetable and animal oils and fats	1,54	2,33	1,53	2,06	Publishing, printing and reproduction of recorded media	2,65	1,65
17-Manufacture of dairy products	1,10	2,19	1,21	1,87	Manufacture of coke, refined petroleum products and nuclear fuels	2,30	2,81
18-Manufacture of grain mill produtcs, starches and starch products	1,57	2,14	1,55	1,81	Manufacture of chemicals and chemical products	2,06	5,82
19-Manufacture of preparad animal feeds	1,33	2,32	1,27	2,04	Manufacture of rubber and plastic products	2,69	2,63
20-Manufacture of bakery products	1,02	2,16	1,03	2,03	Manufacture of other non-metallic mineral products	2,66	2,39

Table 1: 1996 ,1998 ve 2002 Years Total Backward and Forward Linkage Effect of First Twenty Sector (Direct+Indirect)

(Tables was calculated by using the Input-Output Table 1996, 1998 ve 2002 Years)
IBE :Forward linkage effect
GBE:Backward linkage effect

21- Manufacture of sugar	1,37	2,18	1,33	1,94	Manufacture of basic metals	2,35	5,74
22-Manufacture of cocoa, chocolate, sugar confertionery and other food products n.e.c.	1,43	2,02	1,34	1,88	Manufacture of fabricated metal products, except machinery and equipment	2,60	2,17
23-Manufacture of alcoholic beverages	1,24	1,56	1,16	1,51	Manufacture of machinery and equipment n.e.c.	1,94	2,27
24- Manufacture of soft drinks; production of mineral waters	1,27	2,24	1,08	2,10	Manufacture of office machinery and computers	1,17	1,21
25- Manufacture of tobacco products	1,08	2,00	1,08	1,83	Manufacture of electrical machinery and apparatus n.e.c.	2,40	1,96
26-Manufacture of textiles	2,96	2,45	2,67	1,76	Manufacture of radio, television and communication equipment and apparatus	2,21	1,98
27- Manufacture of other textiles	1,26	2,13	1,22	1,68	Manufacture of medical, precision and optical instruments, watches and clocks	1,57	1,20
28-Manufacture of knitted and fabrics and articles	1,13	2,49	1,07	1,76	Manufacture of motor vehicles, trailers and semi-trailers	2,52	1,92
29- Manufacture of wearing apperel, except fur apparel	1,13	2,37	1,53	1,88	Manufacture of other transport equipment	1,73	1,37
30-Dressing and dyeing of fur; manufacture of articles of fur	1,39	2,45	1,01	1,86	Manufacture of furniture; manufacturing n.e.c.	2,85	1,26
31- Tanning and dressing of leather; manufac.of luggage, handbags & harness	1,91	2,46	1,69	1,96	Recycling	3,25	1,02
32-Manufacture of footwear	1,14	2,55	1,07	2,00	Electricity, gas, steam and hot water supply	2,98	4,98
33-Sawmilling and planing of wood	2,19	2,42	2,06	2,08	Collection, purification and distribution of water	1,55	1,38
34- Manufacture of wood and of products of wood and cork	1,43	2,17	1,45	1,98	Construction	2,56	1,54
35- Manufacture of paper and paper products	3,41	2,10	2,39	1,69	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale services of automotive fuel	2,24	2,62
36-Publishing	1,09	1,86	1,09	1,53	Wholesale trade and commission trade, except of motor vehicles and motorcycles	2,13	4,59
37- Printing and service activities related to printing	1,51	2,10	1,52	1,62	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	1,86	3,14
38- Manufacture of coke, refined petroleum produtcs	5,79	1,55	3,92	1,13	Hotels and restaurants	2,53	1,57
39- Manufacture of basic chemicals, plastics in primary & synthetics rubber	4,89	2,16	1,79	1,58	Land transport; transport via pipelines	2,10	4,76
40- Manufacture of fertilizers and nitrogen compounds	1,77	2,16	1,30	1,66	Water transport	1,80	1,89

Table 2: 1996 ,1998 ve 2002 Years Total Backward and Forward Linkage Effect of Second Twenty Sector (Direct+Indirect)

(Tables was calculated by using the Input-Output Table 1996, 1998 ve 2002 Years)

Sectors	1996		1998		Sectors	2002	
	İBE	**GBE**	**İBE**	**GBE**		**İBE**	**GBE**
41-Manufacture of pesticides, other agro-chemicals and paints, varnishes	1,49	2,01	1,32	1,59	Air transport	2,68	1,36
42-Manufacture of pharmaceuticals, medicinal chemicals & botanical products	1,68	1,84	1,27	1,54	Supporting and auxiliary transport activities; activities of travel agencies	2,41	3,38
43-Manufacture of cleaning materials, cosmatics and other chemicals & fibres	2,19	2,06	1,67	1,72	Post and telecommunications	2,20	2,17
44- Manufacture of rubber products	1,47	2,09	1,39	1,72	Financial intermediation, except insurance and pension funding	1,91	4,47
45- Manufacture of plastic products	1,64	2,31	1,56	1,69	Insurance and pension funding, except compulsory social security	1,64	1,26
46-Manufacture of glass and glass products	1,32	1,83	1,28	1,61	Activities auxiliary to financial intermediation	2,54	1,38
47-Manufacture of ceramic products	1,08	1,79	1,10	1,58	Real estate activities	1,59	2,33
48-Manufacture of cement, lime and plaster related articles these items	1,24	1,83	1,44	1,60	Renting of machinery and equipment without operator and of personal and household goods	2,20	1,18
49- Cutting and finishing of stone and man. of other non-metallic mineral products n.e.c.	1,06	1,54	1,04	1,68	Computer and related activities	1,95	1,27
50-Manufacture of basic iron and steel	4,61	2,26	3,28	1,81	Research and development	2,90	1,33
51-Manufacture of basic precious and non- ferrous metals	3,05	2,13	1,80	1,74	Other business activities	1,98	4,64
52- Casting of metals	1,13	2,18	1,28	1,67	Public administration and defence; compulsory social security	2,06	1,02
53-Manufacture of fabricated metal products, tanks, reser.&steam gen.	1,16	2,24	1,50	1,69	Education	1,60	1,14
54- Manufacture of other fabricated metal products; metal working services	2,40	2,10	1,81	1,73	Health and social work	2,32	1,12
55-Manufacture of general purpose machinery	1,51	2,01	1,15	1,68	Sewage and refuse disposal, sanitation and similar activities	2,37	1,43
56- Manufacture of special purpose machinery	2,85	2,02	1,37	1,76	Activities of membership organisation n.e.c.	2,23	1,46
57- Manufacture of domestic appliances n.e.c.	1,10	2,04	1,06	1,57	Recreational, cultural and sporting activities	2,14	1,70
58-Manufacture of office, accounting and computing machinery	1,59	1,61	1,05	1,49	Other service activities	2,23	1,11
59-Manufacture of electrical machinery and apparatus n.e.c.	1,73	2,15	1,26	1,66	Private households with employed persons	1,00	1,00
60-Manufacture of radio, television and communication equip- ment & apparatus	1,82	1,81	1,20	1,44			

Table 3: 1996 ,1998 ve 2002 Years Total Backward and Forward Linkage Effect of Third Twenty Sector (Direct+Indirect)

(Tables was calculated by using the Input-Output Table 1996, 1998 ve 2002 Years)

Sectors	1996		1998	
	İBE	**GBE**	**İBE**	**GBE**
61-Manufacture of medical, precision &optical instruments, watches and clocks	1,29	1,82	1,04	1,56
62- Manufacture of motor vehicles, trailers and semi-trailers	1,60	2,15	1,21	1,72
63- Building and repairing of ships, pleasure &sporting boats	1,10	1,48	1,01	1,54
64-Manufacture of railway and &tramvay lokomo- tives & rolling stock	1,30	1,93	1,02	1,48
65-Manufacture of aircraft and spacecraft	1,18	1,16	1,02	1,23
66-Manufacture of transport equipment n.e.c.	1,39	2,25	1,08	1,66
67-Manufacture of furniture	1,07	2,24	1,08	2,01
68- Manufacturing n.e.c.	1,21	1,96	1,05	1,27
69-Production, collection and distribution of electricity	4,38	1,45	3,69	1,35
70-Manufacture of gas; distribution of gaseous fuels	1,16	1,77	1,18	1,18
71-Collection, purification and distribution of water	1,53	1,25	1,38	1,19
72-Construction	1,06	2,02	1,16	1,67
73-Sale, maintenance and repair of motor vehicles, motorcycles; retail sale of fuel	2,40	1,45	2,17	1,29
74-Wholesale trade and commission trade, except of motor vehicles & motorcyles	5,87	1,39	3,54	1,26
75-Retail trade, repair of personal and household materials	2,65	1,46	2,97	1,25
76-Hotels; camping sites and other provision of short-stay accommodatin	1,61	1,81	1,23	1,69
77-Restaurants, bars and canteens	1,40	1,91	1,80	1,70
78-Transport via railways	1,24	2,20	1,07	1,58
79-Land transport; transport via pipelines	6,05	1,54	5,11	1,35
80-Water transport	2,12	1,80	1,70	1,48
81- Air transport	1,17	1,97	1,20	1,55
82-Supporting and auxiliary transport activities; activities of travel agencies	1,15	2,28	1,03	1,86
83-Post and telecom- nications	2,19	1,38	2,22	1,15
84-Financial intermedediation, except insurance and pension funding	5,34	1,48	5,23	1,43
85- Insurance	1,34	1,74	1,20	1,44
86-Real estate activities	1,51	1,51	1,55	1,52
87-Renting of machinery and equipment without operator & of personal and household goods	1,08	1,60	1,18	1,62
88-Computer and related activities	1,11	1,95	1,13	1,53
89- Research and development	1,28	1,14	1,30	1,61
90- Other business activities	3,42	1,75	2,92	1,48
91-Education	1,02	1,74	1,05	1,53
92-Health and social work services	1,04	1,59	1,03	1,29
93-Activities of membership organizations n.e.c	1,00	1,47	1,04	1,48
94- Recreational, cultural and and sporting activities	1,38	1,53	1,47	1,48
95-Other service activities	1,21	1,63	1,10	1,46
96- Public services	1,00	1,00	1,00	1,00
97-Ownership of dwelling	1,00	1,31	1,00	1,25

Table 4:1996 ,1998 ve 2002 Years Total Backward and Forward Linkage Effect of Third Twenty Sector (Direct+Indirect)

(Tables was calculated by using the Input-Output Table 1996, 1998 Years)

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If the total increase in production caused by the increase in demand by one unit in a sector can be defined as that sector's backward linkage effect and the increase in a certain sector's production by one unit increase in last demand can be defined as that sector's forward linkage effect.

In this context, the study includes calculations of both forward and backward linkage effects for 1996, 1998 and 2002.

When the tables 1,2,3, and 4 above are analyzed, it is seen that sectors with high forward linkage effects have an important place for creating supply to other sectors. Below are the sectors with high forward linkage effects.

As can be seen in Tables 1,2,3, and 4 for the year 1996, the sectors with the highest forward linkage effects are the 79th sector highway transportation (6,05), 1st sector grain and vegetable plantation (5,89), 74th sector wholesale and trade brokering (5,87), 38th sector coke furnace and refined petroleum product manufacturing (5,78), 84th sector intermediary financial institutions (5,34), 39th sector main chemical materials, synthetic rubber and plastic raw material production (4,88), 50th sector iron-steel industry (4,61), 69th sector production and distribution of electricity (4,38), 9th sector crude oil and natural gas production (4,31), 35th sector paper and paper product production (3,40), 51st sector main metal industry other than iron and steel (3,04), and 26th sector textile threads and weaving (2,96). As can be seen the other sectors of the economy used the most input from highway transportation and agricultural sector. The energy sub-sectors such as refined petroleum products and electricity production and distribution are among the first five sectors in terms of providing inputs to other sectors.

As can be observed in Tables 1,2,3, and 4, the highest forward linkage effect sectors for 1998 total (direct and indirect) are; 84th sector intermediary financial institutions and auxiliary activities (5,22), 79th sector highway transportation (5,11), 1st sector grain and vegetable plantation (5,07), 38th sector coke furnace and refined petroleum product production (3,92), 69th sector electricity production and distribution (3,69), 74th sector wholesale and brokering (3,53), 50th sector iron and steel industry (3,27), 75th sector retail, and the repair of personal and home equipment (2,96), 26th sector textile thread and weaving (2,67), and 35th sector paper and paper product manufacturing (2,39).

The sectors with highest forward linkage effects for 2002, as can be seen in Tables 1,2,3, and 4, are; clothing manufacturing (3,21), electricity, gas, steam and hot water production and distribution (2,97), textile manufacturing (2,97), food and drink manufacturing (2,95), leather tanning and processing; suitcase, handbag, saddler, harness and shoe manufacturing ((2,93), research and development services (2,90), wood and cork products manufacturing (2,88), furniture production (2,84), tobacco products manufacturing (2,79), plastic and rubber production (2,69), airway transportation (2,68).

When direct forward linkage effects for 1996 are analyzed, highway transportation, grain and other plants plantation, wholesale and trade brokering coke furnace, refined petroleum products and intermediary financial institutions are the five sectors with highest sector linkage effects.

The highest forward linkage effects for 1998 includes the first five sectors including the production of grain and other plants, highway transportation, intermediary financial institutions, wholesale trade and trade brokering, electricity production and distribution.

The two sub-sectors of the energy sector are among the first five sectors with the highest forward linkage effects in 1996 and 1998.

In 2002, food and drink production, clothing manufacturing, fur processing and dying, wood and cork products production, electricity, gas, steam and hot water production and distribution and research and development services are the first five sectors with highest direct forward linkage effects.

The sectors with the highest forward linkage effects are important for reducing dependency on foreigners since they can be used as inputs in other sectors. In terms of their use as inputs in 1996 and 1998 highway transportation, agriculture and electricity production and distribution, petroleum refinery, iron and steel industry, textile, paper products manufacturing, wholesale trade and trade brokering sectors are remarkable. In 2002, clothing manufacturing, electricity production and distribution, petroleum, textile, leather tanning and processing, shoe manufacturing, tobacco, research and development services, wood and cork products manufacturing, plastic and paper products production, and airway transportation rather than highway transportation came forward.

When we look at the years 1996, 1998, and 2002 together, the sub-sectors of the energy sector such as petroleum refinery, electricity production and distribution,, cruse oil production, coal and nuclear energy production, and natural gas production are among the first sectors that provide inputs to other sectors.

The sectors with the highest backward linkage effects are the sectors which have influence for stimulating the level of production in other sectors. That is, since these sectors demand inputs from other sectors, they stimulate the economy.

When the backward linkage effects for 1996, 1998, and 2002 are analyzed, the high linkage effects of the sub-sectors of the manufacturing industry stand out. It is well known that the manufacturing industry is very important in stimulating the level of production in other sectors in developing countries.

When 1996 backward linkage effects are examined, meat processing and keeping, clothing, leather tanning-suitcase, handbag production, textile threads-weaving sectors are the first five sectors.

In terms of backward linkage effects for 1998, metal industry, chemical materials production, wholesale trade and trade brokering, the activities of financial institutions and highway and pipeline transportation are the first five sectors.

The sectors with the highest backward linkage effects in 1996 are shoe manufacturing, meat processing and keeping, clothing manufacturing, leather tanning-suitcase, handbag manufacturing, and textile thread and weaving and finishing. The sectors with the highest backward linkage effects in 1998 are non-alcoholic beverage and spring water production, timber and hardwood industry, meat processing and keeping, vegetative-bestial oil, animal food production. As seen, the sectors that are the sub-sectors of the manufacturing industry are the sectors with the highest backward linkage effects in 1996 and 1998.

The five sectors with the highest backward linkage effects in 2002 (direct and indirect) are chemical material production, main metal industry, electricity, gas, steam and hot water production and distribution, highway and pipeline transportation, and wholesale trading and trade brokering.

The sectors with high backward and forward linkage effects are described as the locomotives of an economy. When the similar studies are reviewed, it was concluded that the manufacturing industry in the 1980s and 1990s is the locomotive (pioneer) sector. The locomotive sectors in 1996 are plastic products production and iron and steel industries. In 1998, the locomotive sectors are chemical products, synthetic rubber and plastic material manufacturing, iron and steel industry and metal industry.

The locomotive sectors in 2002 are electricity, gas, steam and hot water production and distribution, textile products manufacturing, plastic and rubber products manufacturing, coke coal, refined petroleum products and nuclear fuel production and food and beverage production.

Even though the manufacturing sector was the locomotive sector in the previous years, in 2002, the energy sector became a locomotive sector and contributed to economic revival.

Conclusion

In the years analyzed, the sub-sectors of the manufacturing industry in 1996 and 1998 are the sectors with high direct and total backward linkage effects. In 2002, it is seen that the energy sector has both high backward and forward linkage effects. When the Tables above are analyzed in detail, the sub-sectors of the energy sector score high in terms of both backward and forward linkage effects. According to Hirschman's categorization, the sectors with high backward and forward linkage effects at the same time are described as the locomotive sectors. Therefore, the sub-sectors of the energy sector in 2002 fit in this category.

As a result, investment in the energy sector in Turkey should be increased. In this context, studies aiming to reduce dependency on foreign powers in energy should be done. Especially, the industrial model based on the fossil fuel increases dependency. Turkey can support the other sectors only if can it use resources such as wind, solar and hydrologic energy.

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